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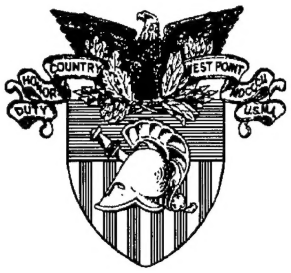

United States Military Academy
West Point, New York 10996

Transforming the Department: 1999–2004

OPERATIONS RESEARCH CENTER OF EXCELLENCE
TECHNICAL REPORT DSE-TR-04-29
DTIC #: ADAXXXXX

Senior Investigator
Colonel Michael L. McGinnis, Ph.D.
Professor and Head, Department of Systems Engineering

May 2004

The Operations Research Center of Excellence is supported by the Assistant secretary of the Army (Financial Management & Comptroller)

Transforming the Department: 1999-2004

Colonel Michael L. McGinnis, Ph.D.
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Abstract

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About the Author

Colonel Mike McGinnis has served as Professor and Head of the Systems Engineering Department, United States Military Academy, from June 1999 to the present. Colonel McGinnis taught in the Department of Mathematical Sciences from 1986-1989. In 1990, he was selected as an Academy Professor in the Department of Systems Engineering. Colonel McGinnis can be contacted at mike.mcginnis@us.army.mil.

Acknowledgements

This report discusses a period of change within the Department of Systems Engineering from 1999 through 2004. The Department's dedicated, professional staff, faculty and students, whose collective efforts made progress possible, deserve the credit for successes achieved so far. At the risk of unintentionally not identifying everyone who contributed, and something I apologize for in advance, there were some who clearly stood out; if only in my mind. Key advisors with whom I regularly consulted: Dr. Don Barr, Major General Rick Lynch, Major General (ret.) Bert Maggart, Ms Betty Melick, Dr. Greg Parnell, Dr. Ed Pohl, Dr. Dave Thomas and my father Jim McGinnis. Key faculty who seized the initiative and led the way even when facing stiff resistance: Barry Ezell, Todd Henry, Mike Kwinn, Dan McCarthy, Willie McFadden, Rich Morales, Rich Richkowski, John Willis. Finally, a special thanks to Dr. Greg Parnell for his thoughtful and insightful editorial comments.

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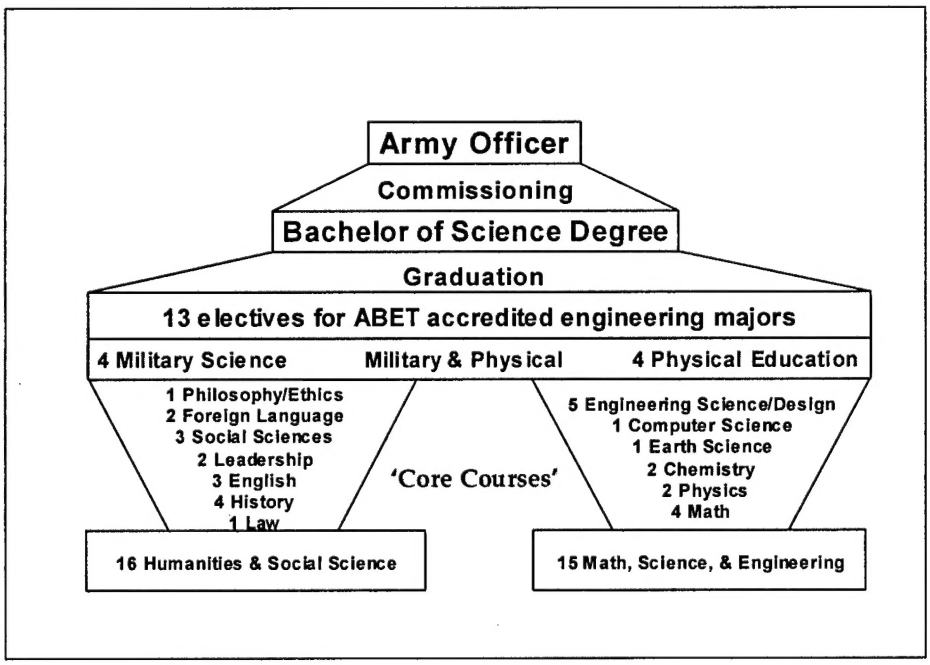
Introduction

The United States Military Academy (USMA), located on the Hudson River at West Point, New York, recently celebrated its 200th birthday. The Academy is the Nation's oldest institution of undergraduate engineering education. Students who successfully complete the academic, military and physical programs graduate with a Bachelor of Science degree and are commissioned as second lieutenants in the Army. All graduates incur a five year active duty service obligation.

The academic program goal of USMA is *"to enable its graduates to anticipate and to respond effectively to the uncertainties of a changing technological, social, political, and economic world"* (Office of the Dean, USMA, 2002). The academic program strikes a balance between breadth across disciplines and in-depth studies within a major. Until recently, the typical core program of study required cadets to take 31 courses as shown in the figure below. Majors in mathematics, science and engineering require an additional 13 electives while humanities and social science majors take ten. In the fall of each year, approximately 1000 sophomores select an academic major from nearly 100 taught in thirteen academic departments.[1]



The Department of Systems Engineering (D/Systems), established in 1989, offers undergraduate majors in systems engineering (SE), engineering management (EM), information systems engineering (ISE) and operations research (OR). The Department's systems engineering and engineering management majors are fully accredited. Information systems engineering and operations research are inter-disciplinary programs. Besides systems engineering, ISE students take computer science and behavioural science courses while operations research majors also take courses in the Department of Mathematical Sciences. Although young by Academy

[1] See www.usma.edu.

standards, the Systems Engineering Department's academic programs rank among the most popular at the Academy with an average of 120 cadets from each class majoring in the Department's programs.

In the summer of 1999, a change in leadership prompted a fresh look at the Department's programs. The purpose of the review and assessment (R&A) was to transform the organization into a more effective and efficient academic department. Senior faculty evaluated long term goals and objectives, analyzed performance measures, and identified redundant, unnecessary policies, processes and activities for elimination. The department leadership also noted that since 1989, key enabling programs such as course development, faculty development, student summer internships, faculty research and curriculum development had essentially been developed and managed as separate, stove-piped programs. This observation led the leadership to its most far-reaching and controversial recommendation for moving the Department forward: To generate synergy and improve efficiency by aligning programs. This report discusses major changes to the Department and the challenges of implementing the recommendations to better align programs.

Getting Started

At the initial review and assessment meeting, the author presented three documents to senior faculty. The first was a charter that specified *what*, *why* and *how* to proceed with the R&A. The charter helped focus thinking and began to shape a shared vision for where we wanted to take D/Systems in the future. The charter also identified constraints and conditions that bounded the review and change process. Most constraints were derived from rules, regulations and policy governing USMA as both an academic institution and a government organization. The rest reflected my leadership philosophy as Department Chair. The second document was a set of tenative timelines, milestones and products to be developed by the senior faculty committee. The third document, called *System6*, was a guide for working through and managing organizational change.[2] The *System6* methodology is a process for iteratively working through six key areas within the context of organizational change: People, partnerships, protocols, performance measures, planning (for action) and pragmatism (getting things done).

Identifying Program Disconnects

Students needed to understand the process before they learn the tools. During the Department's first decade, all majors took an introductory course in systems engineering during either second semester junior year or first semester senior year. Scheduling an introductory course toward the middle or end of matriculation presented problems for students and faculty alike. For much of their time in the academic program, students lacked an understanding of how systems engineering concepts and fundamental "toolkit" courses fit together. Faculty found it

[2] The *System6* methodology was developed, applied and refined by the author while collaborating on strategic Army studies such as Force XXI (1994), OPMS XXI (1996-97), INTEL XXI (1998-99), Army Training and Leader Development Panel (2000), Army Development System XXI (1999-2000) and most recently while serving as the Director of the Army's Unit Manning Task Force (2002-03).

difficult to explain how courses fit into the larger context of systems engineering to students with no holistic understanding of the system engineering and management process. For a discussion of the Department's academic program from 1989 through 1995 see Kays and McGinnis (1995).

Small changes over time can make a big difference. Once selected for a West Point teaching assignment, junior military faculty normally attend a two-year masters program followed by a three-year teaching assignment at West Point. Most first-year instructors focus on lesson preparation and teaching. During the second and third years, instructors move into course directing and research. As course directors, junior military faculty routinely 'tweak' courses. The 1999 R&A revealed that the cumulative effect of numerous minor course changes over a ten-year period caused wide disparities between courses.

- The number of graded events ranged from two or three in some courses to as many as 20 in others.
- Total points in a course varied from less than 1000 to 10,000. [3]
- Instructor grades were often awarded to reinforce behaviour rather than to evaluate learning.
- The percentage of a course allocated to the instructor grade varied widely.
- Within similar types of courses, some routinely had lessons for review and drill while others did not; some covered as many topics as possible while others covered fewer topics in more depth.
- All courses had adopted some form of a course project involving group work.

These differences made a dramatic impact on the consistency and continuity of the Department's academic program. Specifically, idiosyncratic differences between courses left the Department's academic program with no discernible 'feel' to Department of Systems Engineering courses. Second, differences between courses confused and frustrated cadets and faculty. Third, unmanaged course changes blurred the focus of the academic program. For a discussion of differences and development of an introductory 'systems' course see McCarthy et al. (2003).

A missing link in the academic program: Summer internships and capstone design project. Another academic program discontinuity discussed by Kwinn et al (2002) was the student summer internship program. During the summer between junior and senior years, eligible West Point cadets can volunteer for a three-to-four week internship called an Academic Individual Advanced Development (AIAD). These opportunities present students with academically enriching, real-world experiences outside the classroom in their discipline. However, AIAD opportunities were not well coordinated with other Department programs. First, internships were not aligned with ongoing faculty research. Second, the Department did not align internships with the year-long senior capstone where groups of four to six students work on a real-world engineering problem for a client. Third, student capabilities and interests were not lined up with needs of the sponsoring agency.

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[3] There is no evidence that this factor impacted course outcomes or student performance. However, student feedback confirmed that the disparity between a minor quiz in one course with a total point value that exceeded the total point value of a major graded event in another course created unnecessary anxiety and confusion.

Charting the Course

The initial, and perhaps most important, task was to articulate a clear vision for the Department. The starting points for this effort were (1) broadly stated needs of the Army; and (2) goals of the Academy as stated in the USMA mission:

> "*To educate, train, and inspire the Corps of Cadets so that each graduate is a commissioned leader of character committed to the values of Duty, Honor, Country; professional growth throughout a career as an officer in the United States Army; and a lifetime of selfless service to the nation.*" (http://www.usma.edu/mission.asp).

The Department's revised mission, given below, is consistent with Army needs and key elements of the Academy's mission and the Dean's vision. A notable difference between USMA and the Systems Department mission statements is the expectation that the Department's graduates will serve a full Army career as commissioned officers:

> *"To educate cadets in how to think critically, anticipate and respond effectively to technological, social, political, and economic uncertainties of a changing world and, in the process, inspire cadets to be leaders of character who will serve a full career as Army officers."*

Guiding on the Department's mission, senior faculty developed a singular focus for the academic program based on the simple philosophy that we *learn by doing*. In operational terms, we expressed this philosophy as *Do-Know-Be*. That is, doing leads to knowing (understanding) and knowing leads to being (or becoming). For example, faculty and students who repetitively 'do' engineering by applying the engineering thought process and engineering methods taught in the classroom to real world problems will eventually 'know' and understand engineering. Sustained engagment in engineering practice and related activities, over time, imparts the requisite knowledge, skills and attributes for us to 'be' engineers.

The next step was to extend the *do-know-be* learning philosophy to a Department teaching philosophy. First, however, we needed to define an end-state for those who matriculate through the Department's developmental processes. The committee expressed this in terms of five professional attributes we envisioned our students and faculty *becoming*; namely, to develop faculty and students into leaders, problem-solvers, communicators, technologists and team players. With these characteristics in mind, the previous curriculum was redesigned as a *crawl-walk-run* experience that, as expressed in the restated program objectives below, meets Army needs by producing officers who are able to:

- Apply knowledge, skills, and methods to engineer, design, model, analyze, test, prototype, implement and re-engineer large scale, complex systems and processes;
- Solve complex problems;
- Lead multi-functional, interdisciplinary teams;
- Communicate effectively orally and in writing;
- Use and apply technology to solving problems;

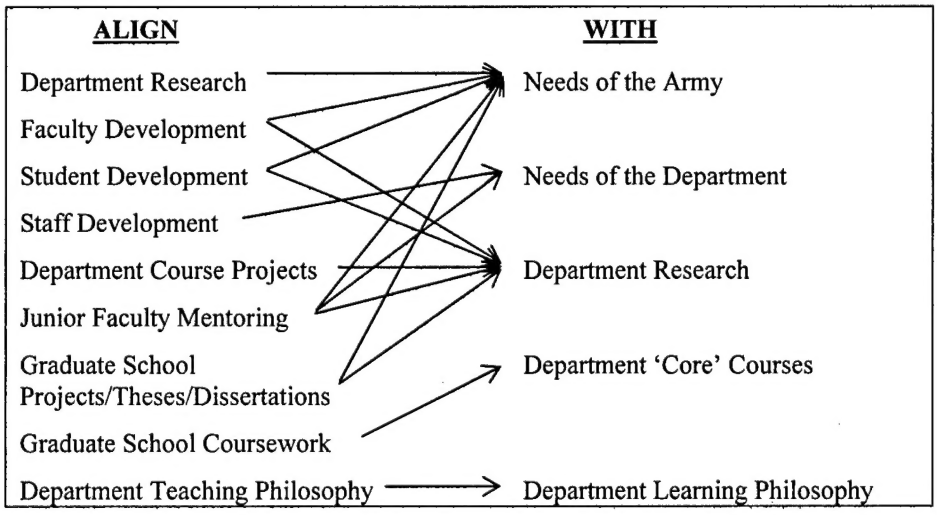
- Be effective, complimentary team members who are able to blend skills and talents with those of other team members.

Before aligning programs, the committee identified and benchmarked metrics for measuring progress and success of the Department's programs over time.

Creating Synergy through Alignment

Aligning programs and processes in people-oriented organizations can produce a profound synergistic effect that yields higher performance and improved efficiency with little or no loss of functionally. This usually improves organizational agility and information flow (formal and informal) as well as lines of control and decision making. However, synchronizing and integrating indpendent, stove-piped programs can also result in tight coupling and conditional dependencies between programs where none existed before. For this reason, the Department Head decided to replace the Department's hierarchical management structure, well suited to administering stove-piped organizations with a flat and matrix-oriented structures that can be tailored to an adaptable, flexible organization essential for operating in a dynamic environment.

The Department's programs that were good candidates for alignment included cadet and faculty development, funding, research, communications, academic promotions, graduate school for incoming faculty, teaching and curriculum development. Key alignments between Department programs are shown in the table below. Several are described in the paragraphs that follow.



Align Department Research with Needs of the Army. The Academy, and the Department of Systems Engineering, exist to serve the Army and the Nation. Given this relationship, the Department faculty agreed to focus their research program on the engineering, problem-solving and analysis needs of the Army and the Department of Defense. While, individual faculty had the academic freedom to pursue more general research interests many of these efforts would eventually support defense needs.

Align Faculty and Student Development with Needs of the Army and Department Research. Applied research, and the application of engineering and analytical methods to solving real world problems is important to the professional development of faculty and students. As engineering faculty, it is through applying what we teach that we gain the knowledge, understanding, and insights not found in textbooks that, when passed on to our students, help them bridge the gap between classroom theory and real world problems. As faculty, we maintain our professional expertise, year after year, by leading our students through a discovery process that provides them with opportunities to acquire requisite knowledge and learn important lessons they will need as future Army leaders.

As explained above, alignment of faculty and student development with needs of the Army and Department research was critical to the Department accomplishing its mission and objectives. Successful alignment was contingent upon implementation of four initiatives: (1) Senior (Ph.D.) faculty undertake and sustain a substantive research agenda involving engineering, operations analysis and applied problem solving (preferably) in support of current Army issues for Army clients; (2) junior (M.S.) military faculty engage in Army-related research or problem-solving during at least one of the three years assigned to West Point (preferably year two); (3) the one-year senior capstone design projects be aligned with the Department research program; and (4) senior (Ph.D.) faculty lead one or more capstone groups of four to six seniors. By linking faculty development goals to research, and having senior faculty direct student capstones, the Department set conditions for students and junior faculty to form collaborative, mentoring relationships with senior faculty. This accelerated and enhanced professional development of students and junior faculty. The support staff were provided training and professional development opportunities aligned with their responsibilities.

Align Staff Development with Needs of the Department. The Department realigned staff on key functions such as technology, budgeting and purchasing, travel support and research support.

Align Department Course Projects with Department Research. The central role of Department research is to generate a steady stream of new, relevant problems for use in class as projects or illustrative examples. The alignment of course projects and individual research provided professors with a steady stream of topics for class projects and examples abstacted from their previous and current research.

Align Junior Faculty Mentoring with Needs of the Army and Department Research. The junior faculty mentoring program was revised to begin as soon as the Department selected new faculty for graduate school; normally 12 to 18 months prior to entering graduate school. Senior faculty were assigned to mentor new faculty and help them select their graduate school program. During graduate school, senior faculty advise students on coursework, help find suitable course projects, theses and dissertation topics, serve on dissertation committees (when practicable), annually visit students in school and meet with graduate school faculty to discuss student progress and review the graduate program.

Align Graduate School Cousework with Department Courses. The Department developed course templates for each graduate school that were aligned with the courses taught in the

Department. As mentors and advisors, senior faculty ensure the graduate school program prepares incoming faculty to teach most of the courses offered by the Department. By taking courses taught by the department, junior faculty are better prepared to teach courses and be academic advisors for cadets.

Align Graduate School Projects/Theses/Dissertations with Needs of the Army and Department Research. Senior faculty encourage and help incoming faculty to find course projects, theses and dissertation topics aligned with on-going Department research for the Army. To facilitate this linkage, the Department initiated an annual two-day research conference at West Point in June for all faculty candidates following their first year of graduate school. The conference overviews Department programs and gives senior faculty an opportunity to discuss current research. This conference helps jump-start research and mentoring relationships with senior faculty before new faculty arrive at the Academy.

Align Teaching and Learning Philosophies. The Department's *learn by doing* philosophy, adopted in 1999, is reinforced by the *do–know–be* approach to faculty development and the *crawl–walk–run* approach to teaching. The underlying premise behind the Department's expectation that faculty engage in engineering and practice is our belief that faculty who *do* engineering will be more effective at teaching engineering. In this, as in all areas, our faculty are expected to lead by example.

Development of a Crawl-Walk-Run Teaching Philosophy. As explained above, prior to 1999, the Department's academic program was front-loaded with 'toolkit' courses that focused on models and analytical methods. The introductory systems engineering course was taught later in the program. In 1999, the curriculum was redesigned as a crawl-walk-run sequence of courses. Beginning in 2003, the academic program started with an introductory systems engineering course (crawl), followed by *method* and *formulation* courses (walk), culminating with a two-semester senior capstone course (run).

Introductory Engineering 'Roadmap' Course: Starting in 1999, the introductory engineering course was redesigned as a 'roadmap' to provide students with a common, initial engineering experience and an understanding of the Department's academic programs. In 2001, the re-titled introductory course, "Introduction to Engineering Design and Systems Management," became the first course for all the Department's ABET accredited engineering majors (see McCarthy et al., 2003).

Method Courses: Mmethod courses teach students, through examples and repetition how to use basic engineering and analytical tools. The educational outcome goal common to all method courses is for students to: (1) solve problems using systems engineering, operations research and engineering management methods; and (2) analyze and interpret output from methods and models. Method courses are exclusively individual work, have no instructor grade, and are capped at ten graded events.

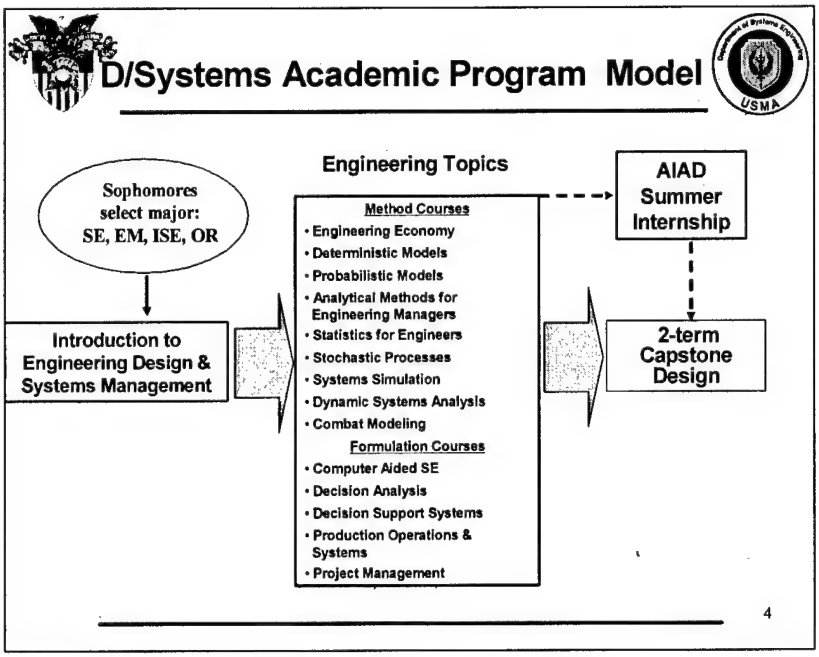
Formulation Courses: Formulation courses focus on defining and formulating problems for the purpose of applying engineering and analytical methods to evaluate competing, feasible

solutions to problems. Faculty emphasize, and reward, creative, imaginative, inside-out, upside-down thinking essential to defining and formulating complex, multi-disciplinary problems. Working in small groups, students learn brainstorming and other ideation techniques, and experience the challenges and dynamics of working as a team to produce products on time. The courses six graded events involve both individual and teamwork with two or three students per team. The percentage of the instructor grade, varying between 10 to 25 percent of the course, is commensurate with the level of group work. For a detailed discussion of method and formulation courses see McCarthy et al. (2003).

Engineering Capstone Design Course: The two-semester engineering capstone design requires four to six students to work as a team for the entire year to solve a 'real' multi-disciplinary problem for a client. Ccapstones teams, led by senior faculty, typically meet with clients several times each term to define the problem and develop and analyze solutions. The project culminates with a formal recommendation and presentation to the client at the end of the year, and presentation of results at the Department's annual, year-end Capstone Conference. Kwinn, et al. (2002) describes details of the Capstone Design program. The goal of the capstone course is to provide majors with opportunities to continue development of time mangement and problem solving skills, practice self discipline and exercise creativity in a multi-disciplinary environment while integrating individual efforts of the capstone group into useful products for clients (Kramer and Pohl, 1997). Grading is split equally between a group grade based on faculty assessment of the quality of engineering and analysis products and an instructor grade based on individual effort and contributions students make while serving as the lead engineer (rotated among team members) and as a capstone team member.

Align AIAD Summer Internships with the Capstone Course. Another important synergistic alignment was linking the AIAD summer academic internship with the senior capstone course. Summer internships are voluntary and must be scheduled around other summer military development activities. For those students able to participate, the AIAD-Capstone link allows them to spend three to four weeks working directly with their future capstone client to define, scope and bound the problem, and identify, interview and analyze stakeholders. This gives students a first-hand understanding of the problem and get started with background research prior to their year-long capstone. The AIAD extends and enriches the capstone experience beyond what occurs in the classroom at West Point.

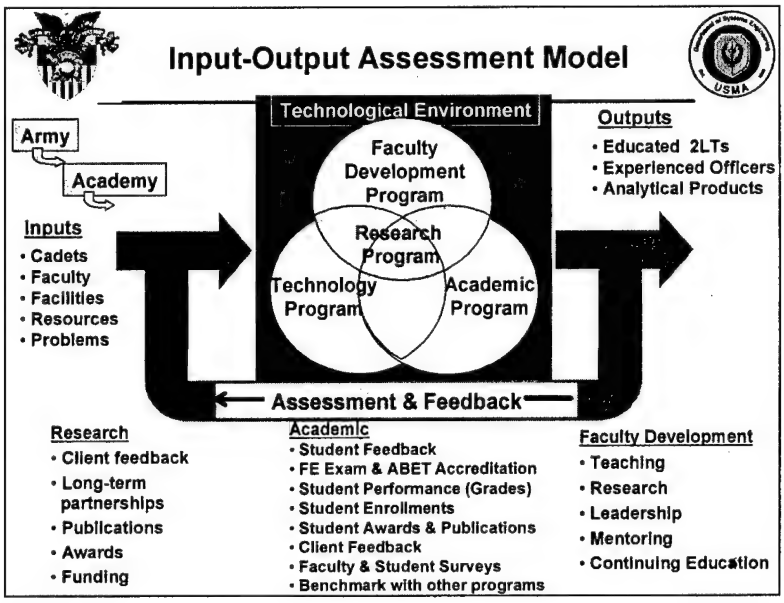
To recap, the major changes to the Department's academic program since 1999 include: (1) redesigning the introductory systems engineering course and making it the first course in the academic program; (2) developing several new courses to cover gaps in the curriculum; (3) expanding the capstone to a two-semester course for the Department's majors; and (4) linking, when possible, summer AIAD internships with the capstone course. The Department's current academic program model is depicted in the figure below.



Other Changes

Centralized Coordination of Research. The Department consolidated and centralized the coordination of all research under the Department's Operations Research Center (ORCEN). Directed by a senior faculty member, the ORCEN serves as the primary point of contact for clients who provide and fund projects and faculty who execute the research program. The ORCEN is staffed by four full time junior analysts (three from the Department of Systems Engineering and one from the Department of Mathematical Sciences) and a research coordination administrator.

Department Input-Output Program Assessment Model with Feedback. No organization can improve without continuous, constructive feedback. Department feedback was expanded to areas shown in the figure below.



The Department formulated and benchmarked program metrics for evaluating progress and success over time in three key areas: research, academics and human resources development. The Department also formed a Board of Advisors consisting of prominent leaders from academia, industry, and Department of Defense who visit the Department annually to review programs and provide feedback.

Department Communications. Another important initiative was to improve how the Department communicated, informed and advertised our programs to cadets, the families of students, the West Point community, alumni, Army leaders, and those who support our programs. Initiatives included a new department crest, a department flag, a line of Department apparel, mugs, coins, two newsletters, overhaul of the internal and external websites. We even adopted a distinctive greeting between faculty, staff and students: "Go Systems" followed by "All Systems Go."

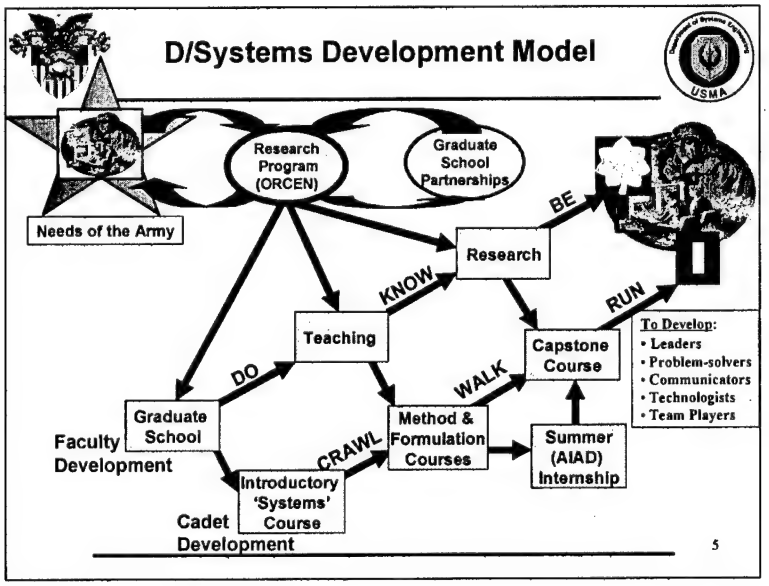
Capstone Conference. The culminating event for the academic year is the Department's one-day Capstone Conference. With the inagural conference in 2001, the Department has set aside a day for seniors to present their final design projects to faculty, clients, distinguished visitors, student design teams from other colleges and universities and underclass students. Presentations are scheduled in tracks according to application areas and methodologies. Panels comprised of faculty and professional practioners judge the presentations in each track. The conference concludes with a banquet the evening of the conference where awards are given for the best presentations in each track. Other universities attending past conferences include the University of Virginia, University of Arizona, George Mason University, University of New Mexico, United States Naval Academy, United States Air Force Academy, United States Coast Guard Academy, and the United States Merchant Marine Academy.

Cadet Outreach Program. The Department initiated a cadet outreach program to include cadets in Department professional, social and athletic activities. Faculty and cadets organized four student cadet chapters, sponsored by professional societies, and aligned with Department

academic programs; namely the International Council on Systems Engineering (INCOSE), American Society of Engineering Management (ASEM), Military Operations Research Society (MORS), and Institute for Operations Research and the Management Sciences (INFORMS). The Department expanded its cadet award program to include recognition of top cadets in each course at the end of each semester. During graduation week, the Department hosts an annual cadet and family awards luncheon as well as other activities such as a Hudson River cruise and golf outing for cadets and faculty.

Quality Teaching Program. To improve the quality of classroom teaching, in both content and technique, the Department instituted a quality teaching program that's stresses a five step approach: Prepare, plan, rehearse, execute and feedback. A key element of the program is a four week Faculty Development Workshop each summer for new faculty. The workshop provides information about West Point, teaching and most importantly repetitive opportunities for new faculty to teach classes and receive feedback from the workshop leaders. In addition, the Department assigns teaching mentors to new faculty who regularly attend class and provide informal feedback.

The figure below summarizes key alignments and linkages between most of the programs as described above. As shown below, program alignment creates tight coupling and dependencies but also generates synergy and enables programs to operate more efficiently.



Conclusions

Lessons Learned. Many factors may be combined to bring about organizational change. Two key factors that motivated change within our department: (1) decisions by senior leaders at the Academy level altered the Department's operating environment; and (2) the Department's leadership pursued transformation from within to achieve new and higher goals. The process of change, undertaken in the summer of 1999, has continued for five years. Major changes will be

implemented by the end of academic year 2003-04. Some lessons learned along the way are shared below.

Strategic Lessons

- Given how difficult it is to bring about meaningful, long-lasting change, forward thinking organizations must set themselves up for dealing with future change by creating a culture that enables the organization to more effectively deal with change.

- Institutionalizing change processes, such as periodic department and curriculum review and assessments, make change part of the organization's operating practices.

- Real change takes time. Department leaders should undertake the task with the mentality of a marathoner not a sprinter. Commit to the long haul and stay the course.

- If the organization pursues transformation, it is important to decide up front (1) *what* changes are absolutely necessary; and (2) *how* to implement changes over time.

Operational Lessons

- Create a clear vision that inspires and resonates with faculty, staff and students. Communicate the vision using multiple channels.

- Once change is undertaken, act quickly and decisively but involve key team members in the change process and allow time for the change to be implemented.

- Celebrate successes and use them to motivate and inspire. Feed success and starve failure. Support and resource individuals who step forward to embrace and lead the change process.

- Performance measures determine the organization's future direction. Once put in place, the organization will realign itself to pursue the metrics. Therefore, selecting the right performance measures is vital to successful transformation and may be the most important decision an organization makes. Think hard and choose them very carefully.

- Be inclusive not exclusive. To the extent possible, open up discussions about the process to the entire organization. Devise ways that enable team members at all levels to provide input.

- Good ideas are where you find them. Encourage and engage in continuous, two-way information exchanges and provide frequent feedback to team members, stakeholders and partners.

- Leaders must listen, remain open to new ideas, give credit where credit is due, take responsibility for things that go wrong and when they do, work to solve the problem.

- Be open, honest and above board in all areas; especially with decisions that effect people. Secrets and secret, closed meetings breed mistrust, uncertainty and misunderstanding. Subscribe to a philosophy of *nothing to hide, nothing to worry about.*

- Tear down walls and build bridges. Crises, challenges and confrontation are part of the change process. Partnerships are very important to surviving crisis situations. Develop trust-partnerships with individuals and organizations that will stand fast and provide steady support during tough times.

- Build trust relationships. What ultimately bond us together are mutual respect, mutual confidence, trust, a shared vision and common values developed over time. These factors are vital to achieving high-trust relationships that foster organizational cohesion and lead to a high-performing organization.

- Change starts at the top. Leaders must lead from the front, lead by example and be cheerleaders; remain positive, patient, confident and optimistic in the face of discontent and adversity.

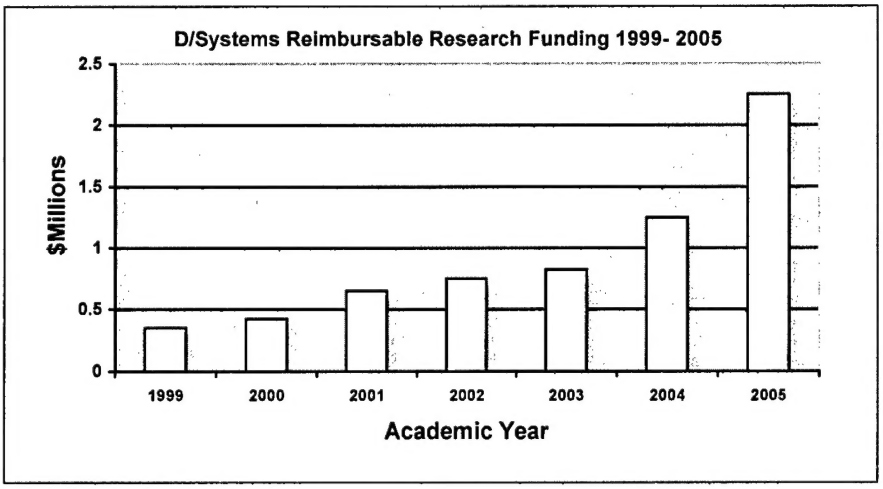
Barriers to Change. As mentioned previously, functional and program realignment can complicate both operations and management of an organization. Information flow, decision making and lines of communication and control may be altered. Unintended, unexpected outcomes may confuse and create uncertainty. Disagreements about organizational change (what and how), and control of the process, can lead to conflicts and power struggles at all levels of the organization. Dissent and disagreements can cause professional relationships to breakdown. Occasionally, this may lead to personnel changes and resignations. In the short to mid term, turbulence and turmoil generated from change can cause a down-turn in organizational performance and morale.

Benefits to the Department. Organizations are about people. Change generates uncertainty, stress and fear. This makes change hard. However, when external, uncontrollable forces perturb the operating environment, the organization has essentially two options: Either do nothing in the hope that the perturbation will pass with no long-term impact on the organization, or envision a new operating environment and respond by adapting the organization to the new future. In spite of how hard it is for organizations to change, when factors make it necessary to do so, the fundamental goal of change, and the ultimate benefit to the organization, is to ensure its continued success and perhaps very existence.

Benefits of aligning Department programs, and most professional activities, with the research program are listed below.

- Path to Academic Promotion. The alignment of research with the academic program helps build a research and consulting program that provides a solid record to support individual faculty promotions. In fact, 100% of the eligible faculty have received academic promotions since 1999. These activities include presentation of research at professional conferences, and publication of results in prominent journals and referred proceedings.

- Generates Funds. Research generates funds that the Department reinvests in student faculty and staff development, state-of-the-art laboratories, and information technologies. Funds enable faculty and students to travel to professional conferences, cover expenses for summer internships, and pay for continuing education and training of faculty and staff. The chart below shows an eight-fold increase in Department research funding since 1999 when the Department undertook alignment of research with faculty development.[4]



- Enhances Prestige of the Department. Alignment of faculty and student research with professional development goals has resulted in a significant increase in publications by faculty. Department faculty continue garner national recognition from prizes and awards which enhance the prestige and reputation of the Department, and helps promote West Point throughout the Army.

- Consulting Support to the Army. Faculty research provides an important source of research, engineering and applied problem solving support to the Army and other Defense organizations.

- Pipeline of New Projects. Faculty research provides a steady stream of new projects and academic material that faculty use in class as examples, projects and capstones topics. Projects are also available to faculty in graduate school for class projects, thesis and dissertation topics.

- Creates Summer Internship Opportunities. Faculty research creates contacts that the Department uses to arrange AIAD opportunities. These include a variety of government agencies, such as military research centers, the Congressional Science and Technology Office, the Assistant Secretary of the Army for Acquisition, Logistics and Technology, and the Army Science Board. Students also experience industry with organizations such as Boeing, Raytheon, Enron, Sikorsky, AIG and USAA among others.

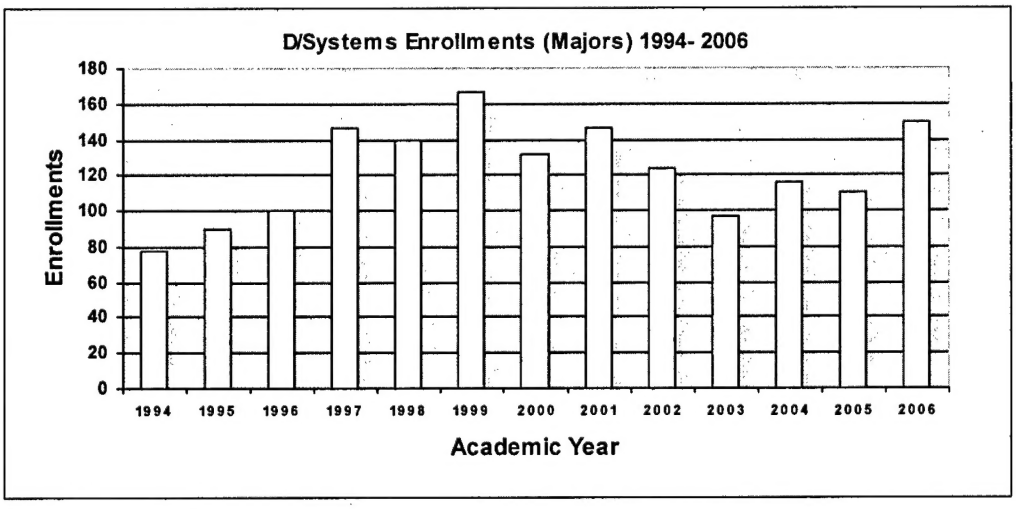
[4] Estimated research funding for Academic Year 2005 based on commitments as of March 2004 from Department of Defense agencies.

Other benefits of generating synergy through alignment are given below.

- Capstone Design Projects Expose Students to Team-building and Group Dynamics. Systems engineering is a team effort. The senior capstone course requires students to work in teams where they learn how to deal with group dynamics when solving real problems under time constraints.

- Real-world Capstone Enriches the Academic Experience. The capstone design course provides cadets with educational enrichment experiences that extend beyond the classroom.

- Enrollments Fell but Going Back Up. For various reasons, the Department experienced a precipitous drop in enrollments of majors with the Classes of 2000 to 2003. Enrollments seemed to level off from 2003 through 2005.[5] Enrollments rose with the Class of 2006. The Department noted several factors contributing to this turnaround: Positive aspects and benefits of curriculum changes taking root; communication campaign to inform students of changes; and perhaps most importantly, students informally communicating benefits and opportunities to underclass cadets.



Based on the performance of faculty and graduates, and stakeholder feedback, alignment of the Department's programs has had a synergistic, multiplier effect on the development of our faculty and students. Measuring progress during the past five years verifies that changes in some areas went very well but not so well in others. We learned lessons along the way that will be applied to our next major review and assessment scheduled to start in the summer of 2004. As we move forward, the Department will remain committed to pursuit of excellence by improving our developmental experience that is designed and focused on preparing faculty and students to

[5] The overall number of students enrolled in courses did not decrease since the department was able to increase the number of students enrolled in the five course Systems Engineering Sequence offered to non-engineering majors.

be the leaders, problem solvers, communicators and team players that the Army needs; especially when leading America's soldiers on tomorrow's battlefields.

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